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QUALIFICATION : **BCOM HONOURS**

MODULE : **QUANTITATIVE MANAGEMENT TECHNIQUES IN LOGISTICS**

CODE : **LMA8X06**

DATE : **JULY 2018 SUPPLEMENTARY EXAMINATION**

DURATION : **180 MINUTES**

TOTAL MARKS : **180 MARKS**

EXAMINER : **DR S CARSTENS**

MODERATOR : **DR K LAMBERT**

NUMBER OF PAGES : **7 PAGES**

INSTRUCTIONS TO CANDIDATES:

- Answer all the questions.
- Question papers must be handed in.
- This is a closed book assessment.
- Read the questions carefully and answer only what is asked.
- Number your answers clearly.
- Write neatly and legibly.
- Structure your answers by using appropriate headings and sub-headings.
- The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

QUESTION 1 **[50 MARKS]**

AutoPart (AP) is a distributor of car parts and has a number of stores in Gauteng. Management is concerned about the high levels of inventory carrying and stockout costs of the Midrand store compared to other similar sized stores. ABC analysis of the inventory carrying cost at the store revealed that one particular part (Part A) is contributing a large percentage to the total inventory carrying cost, as well as a large proportion to stockouts.

Further analysis of the demand patterns of Part A over the past number of years indicated the presence of significant variability making it extremely difficult for the inventory manager to decide on the "correct" order quantity and the time to order. This results in either too much inventory or stockouts. The customers do not place a backorder if the part is not in stock.

The lead time from the manufacturer is relatively consistent at two weeks and the associated order cost is calculated at R50/order. The accountant has indicated that the cost of lost sales is R100/unit and carrying cost is 20 cents/unit per week. The company currently has 30 units in stock.

In their effort to address the inventory issue with Part A, AP obtained the following sales information for the past 10 weeks:

Week	Weekly sales (units)
1	110
2	170
3	210
4	240
5	200
6	170
7	200
8	110
9	200
10	170

In addition, analysis of the sales information over the past year revealed the following weekly sales distribution:

Weekly sales	Probability
110	0.05
170	0.2
200	0.45
210	0.25
240	0.05

After numerous meetings to address the issues of extra stock and stockouts, it was decided that two order policies need to be investigated:

- Order 150 units every week (orders received at the start of the week)
- Order 300 units every second week (orders received at the start of the week)

At this meeting two courses of action were identified:

- use the demand trend and attempt to increase forecast accuracy
- use the probability distribution of Part A to simulate the impact of the two order policies. (For the latter approach ignore the two week lead time and assume that the orders are received from the first week. Account for the order cost when orders are received).

What would your recommendation to AP be?

Random numbers
0.45
0.43
0.14
0.04
0.62

QUESTION 2 **[80 MARKS]**

QS Electronics manufactures a component that is used in the assembly process of an electronic product. They supply to four different companies that manufacture electronic products (EM1, EM2, EM3 & EM4) such as hair dryers, toasters, etc. from two plants in Isando and Rosslyn. The monthly plant capacities are as follows:

Plant capacities (monthly)

Plant	Capacity (number of components)
P1 (Isando)	500
P2 (Rosslyn)	1 000

Currently all components are distributed to the electronic manufacturers directly from the plants. QS use warehouses at the plants at a total monthly rental cost of R795 000 per month. Over the past number of months QS started to experience pressure on their profit margin and subsequent to an investigation it was found that significant cost increases resulted from the current distribution network.

Further analysis resulted in the logistics manager proposing that distribution costs can be reduced by incorporating <u>two</u> warehouses at optimal locations. Note that if QS introduces these warehouses the rental of the plant warehouses may be terminated.

The logistics manager identified three potential warehouses in optimal locations in relation to the electronic manufacturers and the plants and the company has the option of renting any two of these three warehouses (W1, W2 & W3). The warehouse capacities are as follows:

Warehouse capacities (monthly)

Warehouse	Capacity (number of components)
W1	800
W2	700
W3	600

The monthly rental costs associated with these warehouses are as follows:

Warehouse	Monthly rental cost (Rand)
W1	R490 000
W2	R430 000
W3	R390 000

The current transport rates are as follows:

Transport rates (Rand/component) – Plant to electronic manufacturer

	EM1	EM2	EM3	EM4
P1	14	15	20	17
P2	18	19	16	21

The logistics manager at QS estimates the transport rates associated with the proposed network as follows (note that the transport rates take the distance into account):

Transport rates (Rand/component) – Plant to warehouse

	W1	W2	W3
P1	2	13	14
P2	7	9	8

Transport rates (Rand/component) – Warehouse to electronic manufacturer

	EM1	EM2	EM3	EM4
W1	3	4	5	12
W2	6	1	11	10
W3	5	2	12	9

The demands at the electronic manufacturers vary and need to be estimated in association with the electronic manufacturer. The demand estimations at EM1 and EM2 have been finalised and are given below:

Manufacturer	Monthly Demand (units)
EM1	300
EM2	250

Demand at EM3 and EM4 have not been estimated, but the following information is available:

Analysts at QS have applied a number of forecasting techniques to EM3's demand information and the following results are available:

Demand forecasts (next month)

Technique	Forecast (units)	MAD
3-month moving average	430	18.7
exponential smoothing (α = 0.3)	425	16.1
exponential smoothing (α = 0.4)	439	19.3
regression analysis	450	15.9

Analysts have struggled to find an appropriate forecasting method to forecast demand at EM4. However, the following historical monthly demand information is available:

Month	Demand
1	163
2	255
3	148
4	239
5	153
6	253
7	306
8	280
9	295
10	338

In addition, the analysts believe that the sales of the electronic product and the selling price of the electronic product may influence demand of the component. To this end the following information was obtained:

Month	Sales	Price
1	1045	475
2	1610	490
3	860	520
4	1211	420
5	975	410
6	1117	370
7	1066	350
8	1310	300
9	1517	280
10	1246	250
11	1200	373

If minimum cost is the objective, which distribution network would you recommend?

Note: Use the demand information for next month. (Round forecast to exclude decimals).

QUESTION 3 [50 MARKS]

Widgecor distributes widgets from two distribution centres (DC1 and DC2) to four warehouses in a certain region. Each warehouse services a different customer base and as such has experienced different degrees of growth over the past number of years. Management believes that the current warehouse allocation to the DCs may impact negatively on the transport cost. Therefore, the company decided to calculate the minimum total transport cost from the two depots to the warehouses based on an optimal allocation basis. However, the decision was to base this on the estimated customer demand at the warehouses for the following year (2018).

The table below shows the demand at two of the warehouses (A and B) over the last 10 years.

Annual demand

Year	Warehouse A	Warehouse B
2008	4500	4700
2009	4000	5000
2010	4100	5100
2011	3700	4980
2012	3650	5500
2013	3480	5890
2014	4300	5300
2015	3900	5700
2016	5600	6230
2017	5200	6450

The company believes that the 2018 demand at Warehouse A may be estimated with either a 4-year moving average forecast or an exponential smoothing forecast (α = 0.8). The 2018 demand at Warehouse B may be estimated with either a 4-year moving average forecast or a trend regression forecast.
The demand forecasts at the other two warehouses (C and D) were estimated as follows:

Estimated annual demand (2018)

Year	Warehouse C	Warehouse D
2018	10 500	3 450

DC1 has a maximum annual capacity of 15 000 widgets and DC2 has a maximum capacity of 12 000 widgets.

The table below contains the estimated 2018 transport rates from each depot to the warehouses:

Transport rates (Rand/widget)

Depot	Warehouse A	Warehouse B	Warehouse C	Warehouse D
D1	3.50	5.21	2.57	7.81
D2	3.45	4.89	-	8.21

The company used LP to calculate the minimum transport cost of the existing logistics network for 2018 at R103 419.

However, as part of their new strategy the company is considering the outsourcing of various functions including transport. To this end a meeting with a third-party logistics company, TPL Logistics was scheduled at which time TPL was requested to submit a proposal for the transport between the DCs and the warehouses.

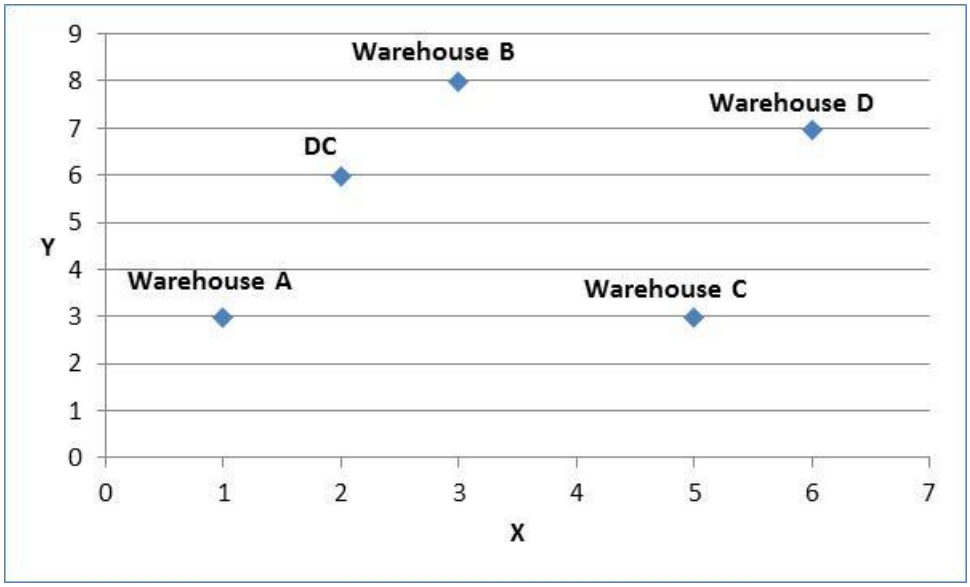
TPL proposed to take over the DCs and the transport of supplies to each of the existing warehouses since TPL has a distribution centre (DC) available with sufficient capacity to store the stock currently kept at the two depots. The idea is to consolidate the stock at this DC and supply each warehouse from the DC.

TPL has proposed the following transport rates from the DC to each warehouse:

Proposed transport rates (cents/widget/km)

	Warehouse A	Warehouse B	Warehouse C	Warehouse D
DC	13	12	19	18

The geographical dispersion of these facilities is as follows:



Note: 1 map unit = 10 km

Would you recommend that Widgecor accept the proposal from TPL, based on transport cost only? Is the DC situated in an optimum location with regards to the warehouses? Assume that the transport cost to supply the two DCs (status quo) is the same as the proposed DC supply cost.

Note: Show all your calculations

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